CHAPTER 6

OPERATION AND PERFORMANCE CONTROL

6-1. General. The success of a dewatering operation finally hinges on the proper operation, maintenance, and control of the system. If the system is not operated and maintained properly, its effectiveness may soon be lost. After a dewatering or pressure relief system has been installed, a full-scale pumping test should be made and its performance evaluated for adequacy or need for any modification of the system. This test and analysis should include measurement of the initial water table, pump discharge, water table in excavation, water table in wells or vacuum in header system, and a comparison of the data with the original design.

6-2. Operation.

a. Wellpoint systems.

(1) The proper performance of a wellpoint system requires continuous maintenance of a steady, high vacuum. After the system is installed, the header line and all joints should be tested for leaks by closing all swing-joint and pump suction valves, filling the header with water under a pressure of 10 to 15 pounds per square inch, and checking the line for leaks. The next step is to start the wellpoint pump with the pump suction valve closed. The vacuum should rise to a steady 25 to 27 inches of mercury. If the vacuum on the pump is less than this height, there must be air leaks or worn parts in the pump itself. If the vacuum at the pump is satisfactory, the gate valve on the suction side of the pump may be opened and the vacuum applied to the header, with the wellpoint swing-joint valves still closed. If the pump creates a steady vacuum of 25 inches or more in the line, the header line may be considered tight. The swing-joint valves are then opened and the vacuum is applied to the wellpoints. If a low, unsteady vacuum develops, leaks may be present in the wellpoint riser pipes, or the water table has been lowered to the screen in some wellpoints so that air is entering the system through one or more wellpoint screens. One method of eliminating air entering the system through the wellpoints is to use a riser pipe 25 feet or more in length. If the soil formation requires the use of a shorter riser pipe, entry of air into the system can be prevented by partially closing the main valve between the pump and the header or by adjusting the valves in the swing connections until air entering the system is stopped. This method is commonly used for controlling air entry and is known as tuning the system; the pump operator should do this daily.

(2) A wellpoint leaking air will frequently cause an audible throbbing or bumping in the swing-joint connection, which may be felt by placing the hand on the swing joint. The throbbing or bumping is caused by intermittent charges of water hitting the elbow at the top of the riser pipe. In warm weather, wellpoints that are functioning properly feel cool and will sweat due to condensation in a humid atmosphere. A wellpoint that is not sweating or that feels warm may be drawing air through the ground, or it may be clogged and not functioning. Likewise, in very cold weather, properly functioning wellpoints will feel warm to the touch of the hand compared with the temperature of the atmosphere. Vacuum wellpoints disconnected from the header pipe can admit air to the aquifer and may affect adjacent wellpoints. Disconnected vacuum wellpoints with riser pipes shorter than 25 feet should be capped.

(3) Wellpoint headers, swing connections, and riser pipes should be protected from damage by construction equipment. Access roads should cross header lines with bridges over the header to prevent damage to the headers or riser connections and to provide access for tuning and operating the system.

b. Deep wells. Optimum performance of a deep-well system requires continuous uninterrupted operation of all wells. If the pumps produce excessive drawdowns in the wells, it is preferable to regulate the flow from all of the wells to match the flow to the system, rather than reduce the number of units operating and thus create an uneven drawdown in the dewatered area. The discharge of the wells may be regulated by varying the pump speed (if other than electric power is used) or by varying the discharge pressure head by means of a gate valve installed in the discharge lines. Uncontrolled discharge of the wells may also produce excessive drawdowns within the well causing undesirable surging and uneven performance of the pumps.

c. *Pumps.* Pumps, motors, and engines should always be operated and maintained in accordance with the manufacturer's directions. All equipment should be maintained in first-class operating condition at all times. Standby pumps and power units in operating conditions should be provided for the system, as discussed in chapter 4. Standby equipment may be required to operate during breakdown of a pumping unit or during periods of routine maintenance and oil change of the regular dewatering equipment. All standby equipment should be periodically operated to ensure that it is ready to function in event of a breakdown of the regular equipment. Automatic starters, clutches, and valves may be included in the standby system if the dewatering requirements so dictate. Signal lights or warning buzzers may be desirable to indicate, respectively, the operation or breakdown of a pumping unit. If control of the groundwater is critical to safety of the excavation or foundation, appropriate operating personnel should be on duty at all times. Where gravity flow conditions exist that allow the water table to be lowered an appreciable amount below the bottom of the excavation and the recovery of the water table is slow, the system may be pumped only part time, but this procedure is rarely possible or desirable. Such an operating procedure should not be attempted without first carefully observing the rate of rise of the groundwater table at critical locations in the excavations and analyzing the data with regard to existing soil formations and the status of the excavation.

d. Surface water control. Ditches, dikes, sumps, and pumps for the control of surface water and the protection of dewatering pumps should be maintained throughout construction of the project. Maintenance of ditches and sumps is of particular importance. Silting of ditches may cause overtopping of dikes and serious erosion of slopes that may clog the sumps and sump pumps. Failure of sump pumps may result in flooding of the dewatering equipment and complete breakdown of the system. Dikes around the top of an excavation to prevent the entry of surface water should be maintained to their design section and grade at all times. Any breaks in slope protection should be promptly repaired.

6-3. Control and evaluation of performance. After a dewatering or groundwater control system is installed, it should be pump-tested to check its performance and adequacy. This test should include measurement of initial groundwater or artesian water table, drawdown at critical locations in the excavation, flow from the system, elevation of the water level in the wells or vacuum at various points in the header, and distance to the "effective" source of seepage, if possible. These data should be analyzed, and if conditions at the time of test are different than those for which the system was designed, the data should be extrapolated to water levels and source of seepage assumed in design. It is important to evaluate the system as early as possible to determine its adequacy to meet full design requirements. Testing a dewatering system and monitoring its performance require the installation of piezometers and the setting up of some means for measuring the flow from the system or wells. Pressure and vacuum gages should also be installed at the pumps and in the header lines. For multistage wellpoint systems, the installation and operation of the first stage of wellpoints may offer an opportunity to check the permeability of the pervious strata, radius of influence or distance to the source of seepage, and the head losses in the wellpoint sytem. Thus, from observations of the drawdown and discharge of the first stage of wellpoints, the adequacy of the design for lower stages may be checked to a degree.

a. Piezometers. The location of piezometers should be selected to produce a complete and reliable picture of the drawdown produced by the dewatering system. Examples of types of piezometers and methods of installation are given in paragraphs G-5c(6) and G-6h(2) of Appendix G. Piezometers should be located so they will clearly indicate whether water levels required by specifications are attained at significant locations. The number of piezometers depends on the size and configuration of the excavation and the dewatering system. Normally, three to eight piezometers are installed in large excavations and two or three in smaller excavations. If the pervious strata are stratified and artesian pressure exists beneath the excavation, piezometers should be located in each significant stratum. Piezometers should be installed at the edge of and outside the excavation area to determine the shape of the drawdown curve to the dewatering system and the effective source of seepage to be used in evaluating the adequacy of the system. If recharge of the aquifer near the dewatering system is required to prevent settlement of adjacent structures, control piezometers should be installed in these areas. Where the groundwater is likely to cause incrustation of well screens, piezometers may be installed at the outer edge of the filter and inside the well screen to monitor the head loss through the screen as time progresses. In this way, if a significant increase in head loss is noted, cleaning and reconditioning of the screens should be undertaken to improve the efficiency of the system. Provisions for measuring the drawdown in the wells or at the line of wellpoints are desirable from both an operation and evaluation standpoint.

b. Flow measurements. Measurement of flow from a dewatering system is desirable to evaluate the performance of the system relative to design predictions. Flow measurements are also useful in recognizing any loss in efficiency of the system due to incrustation or clogging of the wellpoints or well screens. Appendix F describes the methods by which flow measurements can be made.

c. *Operational records.* Piezometers located within the excavated area should be observed at least once a day, or more frequently, if the situation demands, to ensure that the required drawdown is being maintained. Vacuum and gages (revolutions per minute) on pumps and engines should be checked at least every few hours by the operator as he makes his rounds. Piezometers located outside the excavated area, and discharge of the system, may be observed less frequently after the initial pumping test of the completed system is concluded. Piezometer readings, flow measurements, stages of nearby streams or the elevation of the surrounding groundwater, and the number of wells or wellpoints operating should be recorded and plotted throughout the operation of the dewatering system. The data on the performance of the dewatering system should be continually evaluated to detect any irregular functioning or loss of efficiency of the dewatering system before the construction operations are impeded, or the excavation or foundation is damaged.